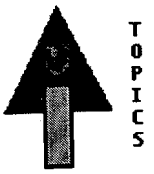

Uncertainty / Probability

(a subtopic of Reasoning)

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Recent News about THE TOPICS (annotated)

18th century theory is new force in computing. By Michael Kanellos. ZDNet (February 19, 2003) / also available from CNET (Old-school theory is a new force). "Thomas Bayes, one of the leading mathematical lights in computing today, differs from most of his colleagues: He has argued that the existence of God can be derived from equations. His most important paper was published by someone else. And he's been dead for 241 years. Yet the 18th-century clergyman's theories on probability have become a major part of the mathematical foundations of application development. Search giant Google and Autonomy , a company that sells information retrieval tools, both employ Bayesian principles to provide likely (but technically never exact) results to data searches. ... 'Bayesian research is used to make the best gambles on where I should flow with computation and bandwidth,' said Eric Horvitz, senior researcher and group manager of the Adaptive Systems & Interaction Group at Microsoft Research. 'I personally believe that probability is at the foundation of any intelligence in an uncertain world where you can't know everything.' ... Bayesian theory can roughly be boiled down to one principle: To see the future, one must look at the past. Bayes theorized that the probability of future events could be calculated by determining their earlier frequency. ... A related technique, called Hidden Markov models, allows probability to anticipate sequences. A speech recognition application, for example, knows that the sound most likely to follow 'q' is 'u.'"

Reasoning Under Uncertainty. From Artificial Intelligence, by David B. Leake, Indiana University [to appear, Van Nostrand Scientific Encyclopedia, Ninth Edition, Wiley, New York, 2002]. "[I]n order to draw useful conclusions, AI systems must be able to reason about the probability of events, given their current knowledge.... Research on Bayesian reasoning provides methods for calculating these probabilities. Bayesian networks, graphical models of the relationships between variables of interest, have been applied to a wide range of tasks, including natural language understanding, user modeling, and medical diagnosis."

A Brief Introduction to Graphical Models and Bayesian Networks. By Kevin Murphy, a postdoc at the MIT AI lab. A great place to start regardless of your level of familiarity!

Stuart Russell on the Future of Artificial Intelligence. Ubiquity; Volume 4, Issue 43 (December 24 - January 6, 2004). "UBIQUITY: Will they be based on a probability theory? RUSSELL: Yes. Speech has already gone this route. Speech recognition is a giant calculation of posterior probabilities from evidence. ... At the same time, logical AI tradition has broadened to include probability theory. A lot of high-level representation, reasoning and planning can go on in a probabilistic formalism."

Bayes Offers a 'New' Way to Make Sense of Numbers. A 236-year-old

REFERENCED → next

approach to statistics is making a comeback, as its ability to factor in hunches as well as hard data finds applications from pharmaceuticals to fisheries. By David Malakoff. (1999). Science Magazine, Volume 286, Number 5444; 1460-1464. "Advances in computers and the limitations of traditional statistical methods are part of the reason for the new popularity of this old approach. But researchers say the Bayesian approach is also appealing because it allows them to factor expertise and prior knowledge into their computations--something that traditional methods frown upon."

Who was Thomas Bayes? Who was Andrei Andreyevich Markov?
See our Namesakes page!

Causality: Models, Reasoning, and Inference. By Judea Pearl (Cambridge University Press, March 2000). "The two fundamental questions of causality are: (1) What empirical evidence is required for legitimate inference of cause-effect relationships? (2) Given that we are willing to accept causal information about a phenomenon, what inferences can we draw from such information, and how? ... This book provides a systematic account of this causal transformation, addressed primarily to readers in the fields of statistics, artificial intelligence, philosophy, cognitive science, and the health and social sciences." - from the Preface. "Links are provided to intoductory sections of all chapters and to selected sections of general interest.

Hidden Markov Models Tutorial from the School of Computing, University of Leeds. " Often we are interested in finding patterns which appear over a space of time. These patterns occur in many areas; the pattern of commands someone uses in instructing a computer, sequences of words in sentences, the sequence of phonemes in spoken words - any area where a sequence of events occurs could produce useful patterns. ... This is typical of the type of system we will consider in this tutorial. * First we will introduce systems which generate probabalistic patterns in time, such as the weather fluctuating between sunny and rainy. * We then look at systems where what we wish to predict is not what we observe - the underlying system is hidden. In the above example, the observed sequence would be the seaweed and the hidden system would be the actual weather. * We then look at some problems that can be solved once the system has been modeled."

Bayesian Networks without Tears. Eugene Charniak (1991). AI Magazine 12 (4):50-63. "I give an introduction to Bayesian networks for AI researchers with a limited grounding in probability theory. Over the last few years, this method of reasoning using probabilities has become popular within the AI probability and uncertainty community."

Formula for 'Clippy' originated centuries ago. Reuters. Available from CNN.com. (April 12, 2001) "Roughly speaking, Bayes' theorem adds common sense to the maths used to work out how likely something is. It introduces yes-

no computers to grey areas, doubt and best guesses."

Association for Uncertainty in Artificial Intelligence (AUAI) homepage.

"B-Course is a web-based interactive tutorial on Bayesian modeling, in particular dependence modeling. However, it is more than just a tutorial. It is also a free data analysis tool that makes it possible for you to use your own data as example data for the tutorial."

Bayesian Belief Nets. A collection of resources from Russell Greiner that includes articles from the popular press, tutorials, applications, research groups and much more.

AI on the Web: Reasoning with Uncertainty. A resource companion to Stuart Russell and Peter Norvig's "Artificial Intelligence: A Modern Approach" with links to reference material, people, research groups, books, companies and much more.

Probabilistic Thinking. By Professor Richard Jeffrey, Professor Emeritus, Princeton; Visiting Distinguished Professor of Social Science, UCI. "Probabilistic thinking was a mid-17th century artifact originating in a famous correspondence between Fermat and Pascal -- a correspondence on which Huygens based a widely read textbook: On Calculating in Games of Luck (1657). The probabilistic framework didn't exist until those people cobbled it together. It remains in use today, much as in Huygens's book. " -from the Preface

Reasoning under Uncertainty in Medical Decision-Support Systems. From the Center for Advanced Medical Informatics at Stanford (CAMIS). "Medicine is replete with uncertainty. In particular, there is uncertainty due to incomplete and inexact scientific models of human health and disease, and there is uncertainty secondary to incomplete and erroneous data about individual patients. We are exploring the use of probability theory as a representation of uncertainty in medical diagnostic systems."

Gister-CL: An Evidential Reasoning System. "SRI's work in automated uncertain reasoning emphasizes the practical application of theoretically sound techniques for reasoning from evidence-that is, information that is potentially incomplete, inexact, inaccurate, and from diverse sources. SRI pioneered evidential reasoning for drawing conclusions from multiple sources of evidential information about dynamic real-world situations." In addition to an overview, you'll find lots of links to the technologies involved and the related applications.

- don't miss possibilistic reasoning: "Possibilistic methods exploit the relations of similarity and of relative preference between alternate explanations of the evidence."

"The Society for Artificial Intelligence and Statistics is a nonprofit organization, incorporated in New Jersey (USA), dedicated to facilitating interactions between researchers in AI and Statistics."

Marek J. Druzdzel's list of software related to the "decision analytic approach to decision making under uncertainty."